

EFFECT OF 1-METHYLCYCLOPROPENE (1-MCP) ON RIPENING BEHAVIOUR, SHELF LIFE AND QUALITY OF MANGO (*MANGIFERA INDICA* L) CV. ALPHONSO UNDER COLD STORAGE

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ABSTRACT

The investigation was undertaken in the Department of Horticulture, College of Agriculture, Dapoli during 2009. The investigation involved completely randomized design with 4 treatments viz, T₁- Cel -fresh 0.18% Tablet (1-MCP)-1Tablet/1M³, T₂- Cel -fresh 0.18% Tablet (1-MCP)-1Tablet / 2M³, T₃- Cel -fresh 0.18% Tablet (1-MCP)-1Tablet / 3M³ airtight fumigation chamber (fruits were kept for 6 hours), T₄-Control.

1-methylcyclopropene resulted in delaying ripening process by 6 to 7 days which was least in T₄ (control) at cold storage. Under cold storage T₂ recorded highest T. S. S. (18.70⁰ Brix), reducing Sugar (3.95 %), total sugar (13.48 %), ascorbic acid (44.43 mg/100g) as compared to control and the rest of the treatments. The highest pulp acidity (0.38 %) was recorded in T₃ as compared to rest of the treatments at ripe stage. From the present investigation it can be concluded that 1-methylcyclopropene was found to be a potent inhibitor of ripening in mango Cv. Alphonso which can an increasing shelf life of fruits, retarding biochemical change and enhancing shelf life of fruits without loss in quality at cold storage temperature. The chemical analysis and sensory qualities of Alphonso mango fruits cold storage conditions indicated that Cel-fresh 0.18% Tablet (1-MCP)-1Tablet/2M³ treatment (T₂) was superior over control and better than other treatments.

KEYWORDS: 1-Methylcyclopropene, Shelf Life, Quality, Alphonso Mango

INTRODUCTION

The mango (*Mangifera indica* L.) fruit belong to family Anacardiaceae and is one of the oldest tropical fruit. It is fifth most widely produced fruit crop in world after banana, citrus, grape, and, apple. It is originated from South East Asia, the Indo-Burma region. It has also an intimated association with cultural, religious, aesthetic, and economical live of the Indians since long time and hence it is national fruit of India (Chatopadhyay, 1976). Mango is most famous for its exotic flavour, delicious taste, attractive colour and several other desirable characters, also titled as 'King of fruits'.

The post harvest losses in mango are 28-30 per cent (Arya, 2004) it being highly perishable commodity. The major causes for post harvest losses are early ripening due to climacteric rise, improper mode of transportation, storage conditions. The export contribution of mangoes is less than 10 per cent of its production. Keeping this in view, an experiment was conducted to find out appropriate 1- MCP treatments to delay ripening and to prolong the shelf-life of alphonso mango. Limited information is available on Alphonso with reference to 1-methylcyclopropene treatment and storage conditions. Therefore a detailed study on these aspects is very much required to preserve the fruits in an acceptable condition for a longer period. This study is essential from the export point of view of Alphonso mangoes. If shelf life of

fruits increased upto 30 days, it can be exported through sea route. This will reduce the freight cost and will boost the export of fresh fruits. Being a major fruit crop and backbone of Konkan economy and export variety of mango, the research work on prolonging the shelf – life will reduce the freight charges of fruits and will fetch higher revenue to the mango growers. In India not much work has been carried out on this aspect in mango.

MATERIALS AND METHODS

The experiment was conducted in the Department of Horticulture, College of Agriculture, Dapoli during May to July, 2009. The experiment was conducted in Completely Randomized Design with 4 treatment viz, T₁: Cel - fresh 0.18% Tablet (1-MCP) = 1Tablet/1M.³, T₂: Cel -fresh 0.18% Tablet (1-MCP) = 1Tablet / 2M.³, T₃: Cel -fresh 0.18% Tablet (1-MCP) = 1Tablet / 3M.³ and T₄: Control. (Without Cel – fresh tablet). The Alphonso mango fruits were harvested at 85 per cent maturity ('B' stage). The unit was 100 fruits per treatment per replication. Fumigation was done by preparing 1m³, air tight fumigation chambers. Fruits were placed in these fumigation chambers for 6hrs with 1-MCP tablet. During fumigation size of fumigation chamber was same only concentration of 1-MCP changed as mentioned in treatments detail. One lot of fruits was kept as such as control. After 6 hrs exposure to 1-MCP 20 crates of Alphonso fruits were placed in walking cooler at (12 ± 1°C and 85-90% RH). Physiological loss in weight was recorded at seven day's interval. Twenty fruits from each treatment of each replication were selected for recording weight of PLW. The loss in weight (g) was calculated by noting down the progressive loss in weight (g) of the fruit recorded from initial day to every seven days under cold temperature storage. The chemical composition viz, TSS (⁰ Brix), acidity (%), reducing sugar (%), total sugar (%), ascorbic acid (mg/100 g. of pulp), were estimated on 0, 7, 14, 21 and 28th day. The chemical analysis was done as per the methods suggested by Ranganna, 1997. The results were analyzed statistically as per the method suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSIONS

- **Effect of Cel Fresh Treatment on Physiological Loss in Weight (PLW %) and Shelf life of Alphonso Mango Fruit in Cold Storage**

The results on effect of Cel fresh treatment on Physiological loss in weight (PLW %) and shelf life of Alphonso mango fruit in cold storage is given in Table 1. The results found that the 1-MCP (0.18%) treated fruits showed higher shelf life i.e. 28.20 days as against control, (20.40 days). However, there was no significant difference was observed between the 1-MCP (0.18%) and control fruits at initial stages. The data depicted in Table 1 reported that treatment T₂ (6.67%) was significantly superior over control (8.43%) and rest of the other treatments of 1-MCP on 28th day of storage. Similar results reported by Feng *et al.* (2000), Calvo (2002), Benassi *et al.* (2003), Chaiprasart and Hansawasdi (2006) 15 days in mango Cv. Nam Dokmai, Jansasithorn and Kanlayanarat (2006) 20 days in Banana. Similar finding also reported by Silva *et al.* (2004) in Rosa and Espada mango, Ortiz *et al.* (2005) in persimmon, Pandey and Singh (2007) in mango Cv. Lucknow Safeda, Manganaris *et al.* (2008) in Joanna Red plums fruits with 100,1000, and 10,000 ng.kg⁻¹ concentration. Also Singh and Pathak (2008) in mango Cv. Dasherri observed same results.

Table 1: Effect of 1-Methylcyclopropene on Shelf life of Alphonso Mango Fruits under Cold Temperature Storage

Treatments	Days to Complete Ripe	Physiological Loss in Weight (%)
T ₁	28.20	6.79
T ₂	28.20	6.67

Table 1: Contd.,		
T₃	27.60	7.46
T₄	20.40	8.43
Mean	26.10	7.41
S. E ±	0.42	0.36
CD at 1 %	1.73	1.47
Result	SIG	SIG

• Ripening Pattern

The results in Table 1 indicated that the all 1-MCP treated fruits required longer time for ripening as compared to control, registering benefited of 7 days over control. The first visible symptom of initiation of ripening that manifested in the form of change in colour from dark green to light green followed by yellow with softening of peel was noticed on 24 days while in control treatment complete ripening was observed on 19.80 days, thereby shelf life was more by 5 to 6 days over control. In control, decaying was observed on 20.40 days while all 1-MCP treated fruits showed decaying after 27 days thereby, significantly 6 to 7 days of advancement in shelf life as compared to control. Treatment T₁ (28.20 days) and T₃ (27.60 days) were at par with treatment T₂ (28.20 days) whereas treatment T₁ and Treatment T₂ was on par with each other. Similar observation was reported by Sisler and Serek (1997), Fan *et al.* (1999); Feng *et al.* (2000), Hofman *et al.* (2001) observed that 1- MCP treatment alone increased the number of the days to ripening 4.4 days, 3.4 days, 5.1 days and 15.6 days for avocado, custard apple, mango and papaya respectively compared with controlled fruits. Argenta *et al.* (2003), Hiwasa *et al.* (2003), Mathur and Srivastava (2005).

• Effect of 0.18 per cent 1-Methylcyclopropene (Cel-Fresh) Treatment on Chemical Properties of Alphonso Mango Fruits

The data pertaining to chemical properties of Alphonso mango fruits as influenced by 1-MCP treatments under cold storage temperature are presented in Table 2.

Table 2: Effect of 1-Methylcyclopropene on Quality of Alphonso Mango Fruits under Cold Temperature Storage

Treatments	TSS (⁰ Brix)	Acidity (%)	Reducing Sugar (%)	Total Sugars (%)	Ascorbic Acid (mg./100 g)	Sensory Score
T₁	17.88	0.31	3.83	13.38	43.01	7.64
T₂	18.80	0.32	3.95	13.48	44.43	7.76
T₃	18.34	0.38	3.92	13.40	43.78	7.73
T₄	17.48	0.25	3.43	13.11	40.57	7.68
Mean	18.12	0.31	3.78	13.34	42.95	-
S. E ±	0.25	0.00	0.01	0.02	0.73	-
CD at 1 %	1.02	0.01	0.04	0.07	3.03	-
Result	SIG	SIG	SIG	SIG	SIG	-

• Effect on Total Soluble Solids

The control fruits showed higher TSS over 1-MCP treated fruits upto 21st day. However, at ripe stage control fruits showed 17.48⁰ Brix TSS while 1-MCP treated fruits showed better TSS (17.88 to 18.80 ⁰Brix) than control. Maximum TSS was recorded in T₂ (18.80 ⁰ Brix) treatment as compared to other treatments at ripe stage. Treatment T₃ (18.34 ⁰ Brix) and T₁ (17.88 ⁰ Brix) were at par with treatment T₂ (18.80 ⁰ Brix). Similar finding observed by Fan *et al.* (1999) in apple, Ortiz *et al.* (2005) in Persimmon, Quiping *et al.* (2006), Singh and Pathak (2008) noted higher level of TSS in Chausa (20.2 ⁰ Brix), Ozkaya and Dundar (2009) concluded that the value of TSS was higher (17.10⁰ Brix) at the

end of the storage period than that of measured at beginning (13.65⁰ Brix), since the starch was converted into sugar (Fuji Apple).

- **Effect on Pulp Acidity**

The study indicated that pulp acidity was more in treated fruits as compared to control fruits upto 28th days. T₂ (0.32 %) treatment was significantly superior over control (0.25%) while treatments T₂ (0.32%) and T₁ (0.31%) were on par with each other. The significant lower acidity was recorded in control compared of 1-MCP treated fruits was probably due to earlier ripening of control fruits as compared to 1-MCP treatment fruits. It could be observed that there was continuous decrease in the acidity from ripening till the end of storage period. The decline in acidity throughout the period of storage could be attributed to degradation of organic acids during ripening and post ripening storage. The lowest decrease in acidity during cold storage was possibly due to delay in ripening and slower degradation of organic acids as results of 1-MCP treatment, low temperature and high humidity. These were in conformity to the observation reported by Fan *et al.* (1999) in apple, Argenta *et al.* (2003) in Plum (34% higher), Cocozza *et al.* (2004) in Tommy Atkins mango, Pandey and Singh (2007) in mango Cv. Lucknow Safeda, Ramin (2008), and Ozkaya and Dundar (2009) in Fuji Apple, its may be due to inhibitory effect of 1-Methylcyclopropene on ethylene synthesis and subsequently on ripening.

- **Effect on Reducing Sugar**

The reducing sugars contents was higher in control fruits than in 1-MCP treated fruits upto 14th days however higher reducing sugar were recorded in T₂ treatment i.e. 3.95 per cent on 28th day storage while treatment T₄ recorded lowest total sugars 3.43 per cent. Treatment T₃ (3.92%) was at par with treatment T₂ (3.95%).

- **Effect on Total Sugars**

The data indicated that total sugar percentage was also influenced by 1-MCP treatment during cold storage study. The total sugar content in Alphonso mango in control was significantly higher as compared to 1-MCP treated fruits upto 21st days however; significantly higher total sugars were recorded in T₂ treatment (i.e. 13.48 %) on 28th day storage. Treatment T₁ (13.38%) was at par with treatment T₃ (13.40%). The increases in total sugars during storage ripening could be attributed to hydrolysis of starch into sugars. Similar finding observed by Fan *et al.* (1999) in apple, Ortiz *et al.* (2005) in Persimmon, Quiping *et al.* (2006), Singh and Pathak (2008) noted higher level of total sugars in Chausa (15.84 %), Ozkaya and Dundar (2009) reported that the value of total sugars was higher (13.10 %) at the end of the storage period than that of measured at beginning, since the starch was converted into sugar (Fuji Apple).

- **Effect on Ascorbic Acid**

The data on ascorbic acid content in Alphonso mango fruits pertaining in Table 2 did not showed any significant difference among the treatments upto 21st days. Maximum value (44.43 mg/100g) in T₂ treatment and lowest value (40.57 mg/100g) was found in control on 28th day of storage. The decline in ascorbic acid during ripening and post ripening storage could be possibly being due to its degradation during this period. Similar results were observed by Selvarajah *et al.* (2001) in stored pineapples, Quiping *et al.* (2006) in sapota.

- **Sensory Evaluation**

Results presented in Table 2 regarding sensory qualities of Alphonso mango fruits were based on organoleptic evaluation in respect of pulp colour, flavour and texture at ripen stage indicated that 1-MCP treated fruits (T₂) obtained

significantly more score over control except T₃ which were at par with 1-MCP treated fruits. Identical observations were obtained by Feng *et al.* (2000), Huber *et al.* (2003) in avocado fruit, Silva *et al.* (2004), Chaiprasart and Hansawasdi (2006), Penchaiya *et al.* (2006).

SUMMARY AND CONCLUSIONS

The study found that the 1-MCP (0.18%) treated fruits showed higher shelf life i.e. 28.20 days as against control, (20.40 days). The study also reported that treatment T₂ (6.67%) was significantly superior over control (8.43%) and rest of the other treatments of 1-MCP on 28th day of storage. All 1-MCP treated fruits required longer time for ripening as compared to control, registering benefited of 7 days over control. 1-methylcyclopropene resulted in delaying ripening process by 6 to 7 days which was least in T₄ (control) at cold storage. Under cold storage T₂ recorded highest T. S. S. (18.70⁰ Brix), reducing Sugar (3.95 %), total sugar (13.48 %), ascorbic acid (44.43 mg/100g) as compared to control and the rest of the treatments. The highest pulp acidity (0.38 %) was recorded in T₃ as compared to rest of the treatments at ripe stage. From the present investigation it can be concluded that 1-methylcyclopropene was found to be a potent inhibitor of ripening in mango Cv. Alphonso which can increase shelf life of fruits, retarding biochemical change and enhancing shelf life of fruits without loss in quality at cold storage temperature. The chemical analysis and sensory qualities of Alphonso mango fruits cold storage conditions indicated that Cel-fresh 0.18% Tablet (1-MCP)-1Tablet/2M³ treatment (T₂) was superior over control and better than other treatments.

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APPENDICES

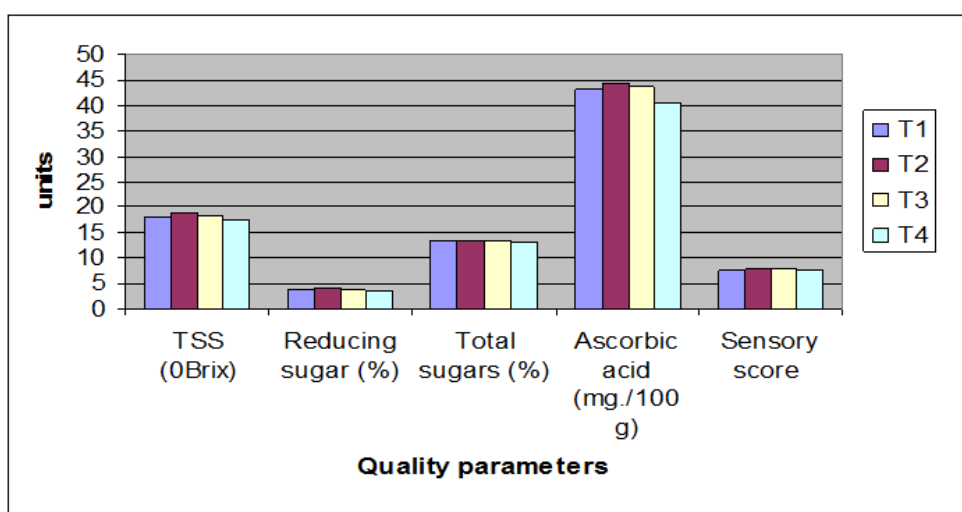


Figure 1: Effect of 1- Methylcyclopropene on Quality of Alphonso Mango Fruits under Cold Temperature Storage

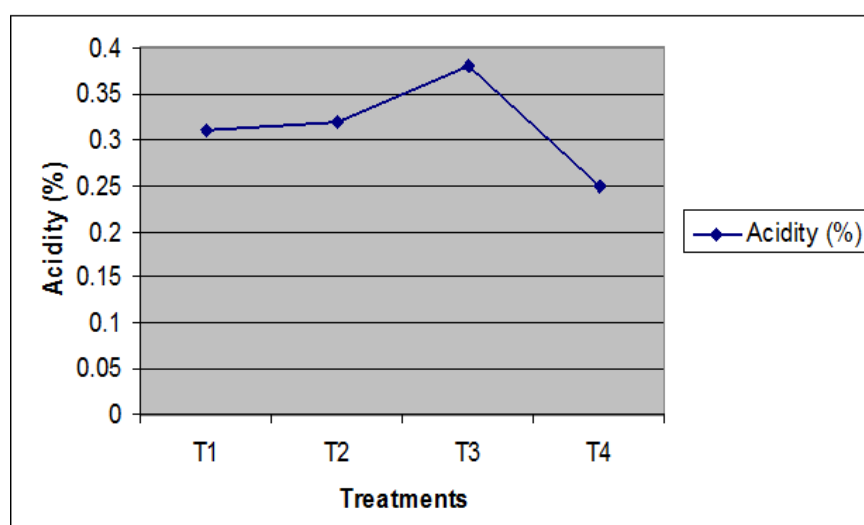


Figure 2: Effect of 1- Methylcyclopropene on Acidity(%) of Alphonso Mango Fruits under Cold Temperature Storage

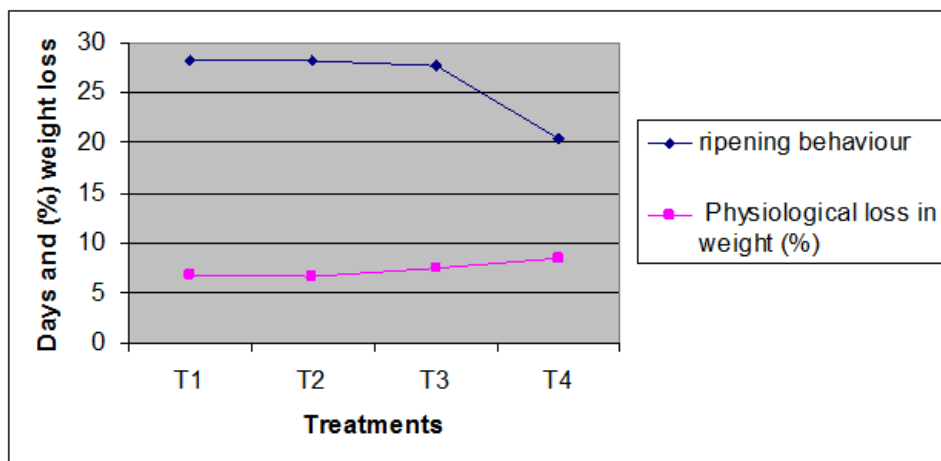


Figure 3: Effect of 1- Methylcyclopropene on Shelf Life of Alphonso Mango Fruits under Cold Temperature Storage